IMDC

International Marine and Dredging Consultants (IMDC) is an engineering and consultancy company specialized in a vast range of water related projects. Our highly qualified staff offers advice based on recent research results of leading universities and research institutes and hands-on experience acquired throughout the years.

The numerical IMDC Scheldt model is presented in this product sheet.

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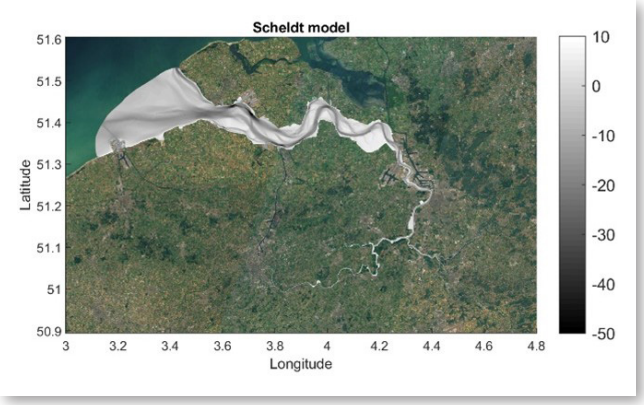
The numerical IMDC Scheldt model

The numerical Scheldt model is developed in TELEMAC-3D and is able to simulate the hydrodynamics in the total Scheldt estuary, including a small part of the Belgian coastal zone and the mouth of the Western Scheldt.

TELEMAC is an open source finite element software package. TELEMAC 3D solves the Navier Stokes equations with or without assuming hydrostatic pressure. It is also able to calculate intrinsic parameters such as temperature, salinity, and sediment concentrations with the advection-diffusion equations.

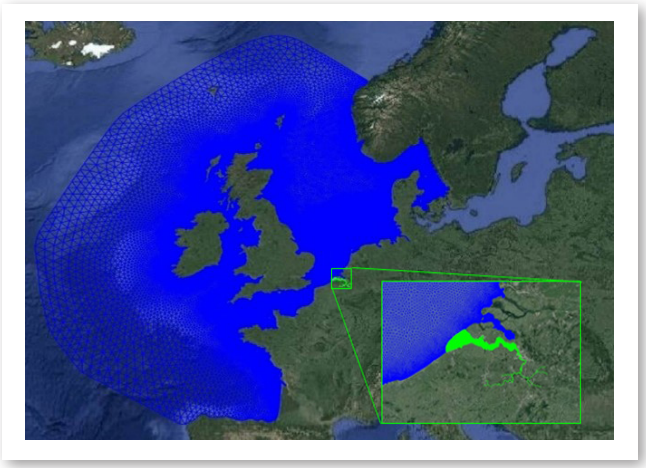
The grid of the Scheldt model consists of unstructured triangular elements. It contains 163335 calculation points in the 2D grid and 296428 elements. Five points are used for the vertical discretization. This leads for the 3D model to 816675 calculation points. These 5 vertical layers are located from the bottom to the water surface (expressed as a percentage of the water depth) at 0%, 12%, 30%, 60% and 100%. The horizontal resolution (length of the sides of the triangular elements) varies between 3.6 m and 400 m. In the coastal strip the resolution varies between 200 m and 400 m depending on the depth. The resolution in the Western Scheldt is approximately 120 m. In the Sea Scheldt, the resolution increases from 30 m at Antwerp till 8 m in the Upper-Sea Scheldt.

The model bathymetry is based on several bottom soundings, which have been executed between 2007 and 2016.



Bathymetry of the Scheldt model [mTAW]

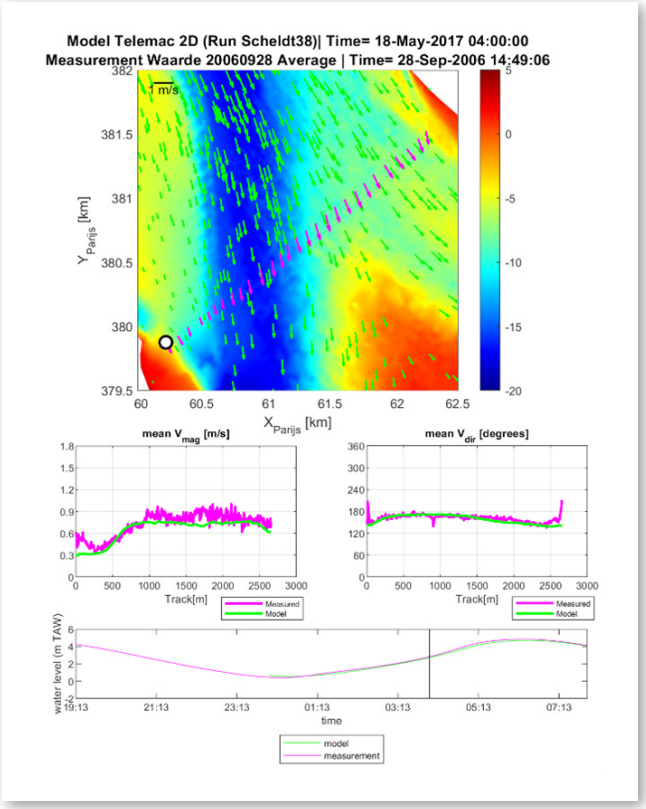
The model contains an open downstream boundary at the sea mouth of the Western Scheldt and eight upstream boundaries. Time series of water levels, velocities, salinity and suspended sediment concentrations are imposed on the open downstream boundary. The time series of water levels and velocities come from the large-scale inhouse developed hydrodynamic iCSM model. This large-scale model takes both tidal and meteorological forcing into account.



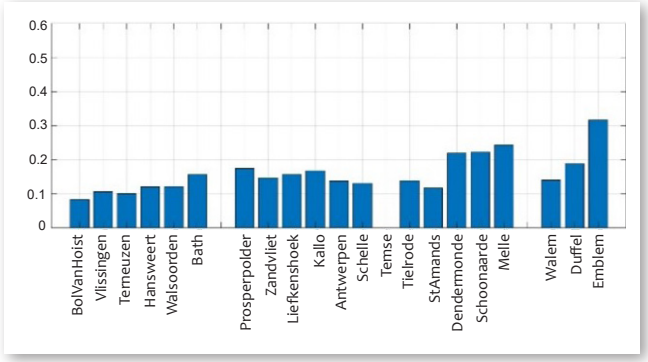
Overview of the model grids: iCSM model (blue), Scheldt model (green)

A computational timestep of 10 seconds is used in the numerical Scheldt model. As a result of this, the CPU-time needed to simulate a spring-neap cycle is approximately 2,5 hours.

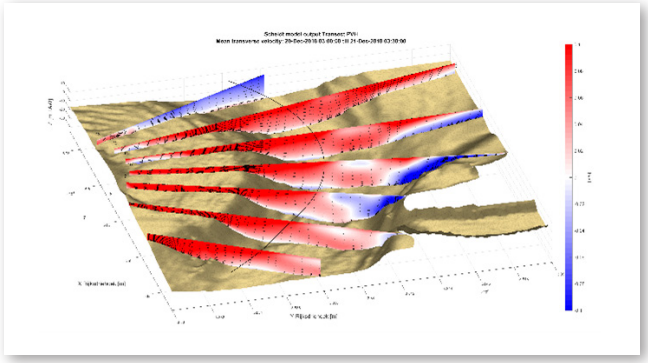
Model results have been calibrated against measured water levels and flow velocities (stationary measurements and ADCP tracks). The average RMSE near the mouth of the Western Scheldt is around 0.11 m and increases upstream up to 0.29 m near Melle.



Validation of flow velocities in the Scheldt model with ADCP flow measurement



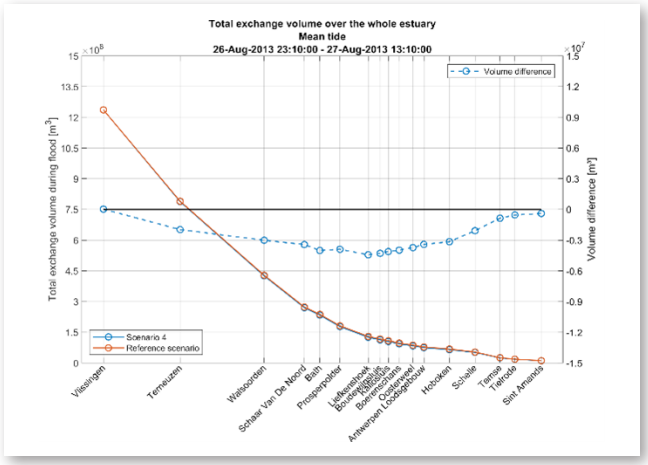
RMSE [m] of the water level in het Scheldt model for one spring-neap cycle



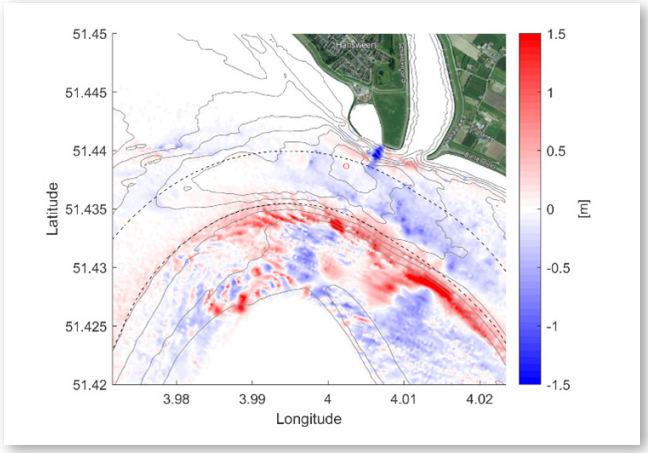
Application: Analysis of complex flow in a bend and secondary circulations due to presence of salt

Given the fact that the model grid and number of vertical layers are adjustable, the Scheldt model is flexible deployable for different projects. Through coupling with multiple modules (e.g. GAIA, WAQTEL), the Scheldt model can be utilized for:

- The analysis of local complex 3D-velocity patterns (including effects of salinity)
- Scenario-analysis of interventions in the Scheldt (e.g. construction of soft and hard structures, disposal of sediments, etc.)
- Morphological studies
- Sedimentation related studies (support during dredging works)
- Tracing of intrinsic parameters or particles in the Scheldt (e.g. sediment plumes, plastics, etc.)
- Water quality modelling



Application: Studying the effects of interventions on the tidal prism along the Scheldt



Application: Morphodynamic modelling

REFERENCES

1: Chu et al. (2020), Improvement of a Continental Shelf Model of the North Sea.

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